

of the rotation of the two bodies in the initial configuration, but it may be asserted that the period is less than $5\frac{1}{4}$ hours, by an amount which is uncertain but probably considerable. I give the period of from 2 to 4 hours, because it is mechanically impossible for the moon to revolve round the earth in less than 2 hours, and the conditions and mode of rupture of the primeval planet are of course unknown.

This theory is founded upon a *vera causa*, viz: tidal friction, but it requires that there should not be enough matter scattered through space to materially resist the motions of the moon and earth. It also demands a sufficient lapse of time. I have however proved that the minimum time, required for the transformation of the system from its primitive state down to the present state, is 54 million years. The actual time elapsed would of course be probably very much longer than this.

On reviewing the systems of the other planets many circumstances favorable to the theory are found, and none which appear at present quite unfavorable. But the dynamical theory of a planet attended by several satellites has not yet been investigated.

The theory gives an interesting explanation of the

rapid movement of the inner Satellite of Mars, and also of the inclinations of the orbits of Jupiter's Satellites to their proper planes.

The celebrated nebular hypothesis of Laplace and Kant supposes that a revolving nebula detached a ring, which ultimately became consolidated into a planet or satellite, and that the central portion of the nebula continued to contract and formed the nucleus of the sun or planet. The theory now proposed is a considerable modification of this view, for it supposes that the rupture of the central body did not take place until it was partially consolidated, and had attained nearly its present dimensions.

It remains however to be seen how far the theory of frictional tides can explain the systems of planets attended by several Satellites, and the Solar System itself.

At present it appears to me that a theory which brings into quantitative correlation the periods of rotation and revolution of the earth and moon, the obliquity of the ecliptic, the inclination to the ecliptic and eccentricity of the lunar orbit must have considerable claims to acceptance.

G. H. Darwin.

Elements of $O \Sigma 235$.

| | | | | | | | |
|----|--------------------------|----------------------------|--------------------------|--------------|---------------|--------------------------|---------------|
| I | $\Omega = 96^{\circ}17'$ | $\lambda = 129^{\circ}55'$ | $\gamma = 60^{\circ}13'$ | $e = 0.5870$ | $a = 1''.066$ | $P = 94^{\text{yrs}}406$ | $T = 1839.10$ |
| II | $= 99^{\circ}35'$ | $= 134^{\circ}55'$ | $= 54^{\circ}27'$ | $= 0.5000$ | $= 0''.980$ | " | " |

| Observer | Epoch | ζ_0 | φ_0 | $\zeta_0 - \zeta_1$ | $\varphi_0 - \varphi_1$ | $\zeta_0 - \zeta_2$ | $\varphi_0 - \varphi_2$ |
|-----------|---------|--------------------|--------------------|---------------------|-------------------------|---------------------|-------------------------|
| Madler | 1843.61 | 282 ^o 7 | 0 ^{''} 53 | — 2 ^o 7 | — 0 ^{''} 02 | — 2 ^o 0 | — 0.03 |
| O. Struve | 44.90 | 293.0 | 0.60 | + 0.6 | + 0.04 | + 1.1 | + 0.02 |
| " | 46.94 | 311.3 | 0.55 | + 8.3 | — 0.03 | + 8.7 | — 0.04 |
| " | 49.89 | 318.6 | 0.52 | + 0.3 | — 0.06 | + 0.9 | — 0.08 |
| " | 51.42 | 327.9 | 0.54 | + 1.5 | — 0.03 | + 2.4 | — 0.06 |
| " | 52.94 | 331.5 | 0.55 | — 2.9 | — 0.02 | — 1.8 | — 0.04 |
| " | 56.51 | 348.8 | 0.53 | — 4.0 | — 0.06 | — 2.4 | — 0.08 |
| " | 58.92 | 358.7 | 0.68 | — 5.5 | + 0.05 | — 3.9 | + 0.04 |
| " | 61.74 | 15.6 | 0.68 | — 0.4 | + 0.01 | + 1.0 | 0.00 |
| " | 65.46 | 29.3 | 0.81 | + 0.6 | + 0.04 | + 1.3 | + 0.05 |
| Dembowski | 68.59 | 38.2 | 0.84 | + 1.0 | 0.00 | + 0.9 | + 0.01 |
| O. Struve | 71.53 | 40.2 | 0.99 | — 3.6 | + 0.07 | — 4.3 | + 0.09 |
| Dembowski | 77.26 | 55.5 | 1.07 | + 1.5 | 0.00 | — 0.5 | + 0.04 |
| Wilson | 77.43 | 55.0 | 1.09 | + 0.8 | + 0.02 | — 1.3 | + 0.06 |

Markree 1879, December 15.

W. Doberck.